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ARTICLES

SOME MICROCLIMATIC CONSIDERATIONS OF AGRICULTURAL INTEREST

By F. LOEWE

Introduction

The meteorological conditions near the ground and at the level of crop plants differ considerably from those shown by the instruments in meteorological screens, data from which are found in the publications on weather and climate. The climate at the level of crop plants is not only different, but varies considerably more over short distances than that at screen level. The region for which a meteorological station can be considered as representative, contains many different microclimates, particularly in hilly or mountainous country. Moreover, the plants themselves modify the climate in their surroundings in many ways, and these variations change strongly with the growth of the crop. The strongest influences of this kind are evidently caused by forests, but they are outside the scope of this article.

It is practically impossible to maintain a sufficient number of meteorological stations to cover even the most important microclimatic divisions of a certain region. However, it is desirable for the evaluation of a certain site for agricultural purposes, to know the typical deviations of the plant climate from the screen climate.

The Inclination and Aspect of Slopes

Solar radiation is the ultimate source of energy for plant life. The intake of radiation by the ground or by the plants themselves varies strongly with latitude, season, cloudiness and the absorptive properties of the surface. These factors, particularly the first three, are well known. In addition, the exposure, that is the direction and steepness of slopes, is of great importance, as incidentally the derivation of the word "climate" from the Greek word for "inclination" indicates.

Table I shows, for the average day of the year, the solar radiation at 32°S. latitude (for example, Perth) upon slopes of different aspect and inclination. Values in brackets refer to the latitude of 52°S. corresponding to that of the Midlands of Great Britain. The values are expressed as a percentage of those received by horizontal ground.

Slopes facing northerly directions get more solar radiation than a horizontal surface, and slopes of 20-25° inclination are particularly favoured. The differences are even bigger in higher latitudes as the values in brackets show.

Seasonal Effects of Insolation

The relative insolation of slopes of different exposure varies strongly with the season, and Table II shows for a slope of 20° at 32°S. latitude (in brackets for a slope of 30° at 52°S. latitude) the intake of radiation in different seasons as a percentage of that received by a horizontal surface in these latitudes and seasons.

According to Table II the northern slopes are particularly favoured in winter when exposure becomes most important for winter crops, whilst in summer there

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TABLE I

Annual radiation intake of different surfaces.

Aspect	Inclination						
	5°	10°	20°	30°	40°	50°	90°
North	105	110	114	115 (128)	113	108	60 (86)
North East, North West ..	103	106	109	109	105	101	61
East, West	99	98	96	91 (91)	86	79	45 (51)
South East, South West ..	96	92	82	70	59	49	20
South	94	88	74	59 (51)	45	33	9 (3)

is hardly any difference between the different exposures and the horizontal surface. A north-facing slope of 20° at latitude 32°S. receives as much solar radiation in a year as a horizontal surface at 17°S. latitude whilst a neighbouring south-facing slope of the same inclination gets no more than a horizontal field at 55°S. latitude. Slopes only a few hundred yards from each other differ in their insolation as much as the Northern Territory and Heard Island.

These differences in insolation of neighbouring slopes have very important consequences regarding the distribution of crops. For instance, in the upper Rhone Valley in the European Alps, northern slopes are forested whilst the southern slopes form a region of steppe-like vegetation and of agriculture with irrigation.

The same differences apply also to differently exposed walls. At 32°S. latitude, an East or West wall receives during 4 months of summer two and a half times as much radiation as North wall, and it will come as a surprise that north of 34°S. latitude the North wall receives in midsummer less radiation from the sun than any other wall, less even than the South wall. In latitudes higher than 34°S. the North wall receives more than the South wall. This may be of interest to the growers of passion fruit or tomatoes or for the construction of drying sheds and silos.

It should not be overlooked that the back radiation of reflected light increases the intake of solar energy by plants growing along walls. This applies particularly to white walls, and it has been shown in Central Europe that the increase in yield of tomatoes following the use of white paint on walls may justify the added expense.

The importance of surface colour

The colour of the receiving surface is of great importance in determining the proportion of absorbed and reflected light. Freshly fallen snow reflects about four-fifths of the radiation from sun and sky and absorbs only one-fifth whilst

Table II

Seasonal Intake of radiation for slopes of different exposure.

Aspect	June	Sept., March	December
South	35 (0)	74 (24)	97 (72)
South West, South East	55	80	97
West, East	95 (97)	97 (92)	97 (89)
North West, North East	133	110	96
North	152 (300)	118 (150)	95 (102)

freshly ploughed dark soil absorbs up to nine-tenths. In order to increase the absorption of solar radiation, and so hasten the melting of snow from fields and meadows and to lengthen the period of plant growth, one may cover the snow with a thin layer of sand and gravel. This has been used for a long time by the inhabitants in the northern valleys of Kashmir and also in parts of Central Norway. If, on the other hand, the layer of earth is thick, the heat from the surface will not penetrate to the snow and the snowbeds will be preserved into the summer as a source of water for irrigation. This method, too, is used in the desert valleys of northern Kashmir.

The Intake and Loss of Heat Radiation by the Ground

The radiative intake and the amount of outgoing radiation of the ground influence strongly the temperature at the surface and of a shallow layer below. These layers are characterised by the high temperatures which they can attain under the influence of insolation. A temperature of 160°F. is frequently exceeded. The parts of the plant in immediate neighbourhood of the ground can be exposed to temperatures not far from boiling point, and, for instance, young beans and pine seedlings are known to be killed by what amounts to burning at the level of the surface. On the other hand the night temperatures of the surface are lower than those of the air at some distance above. The minimum temperature of the ground at night is determined by the heat loss from outgoing radiation and by the compensating flux of heat from the deeper, warmer layers of the ground. In this regard, the heating by warmer air is generally insignificant. The smaller the heat conductivity of the ground the less heat will be supplied from below.

The effect of plant litter and ploughing

On account of its loose texture, plant litter is a very poor heat conductor, and neglect in this respect will easily cause frost damage to young plants. The following example shows the frost danger at places of identical elevation and exposure, some having a surface of litter, others of ploughed soil.

	Average temp. of thirty cold spring nights (in degrees F.)	Number of Spring frosts
Slight hollow; litter, weeds	31	17
Level; litter, weeds	32.5	15
Ploughed two years ago; some litter, weeds	38	9
Freshly ploughed	39	6

In this case the ploughing destroyed the badly conducting litter layer. On the other hand, with uniform soil, ploughing increases the air spaces and, by diminishing the heat conductivity of the soil, increases the danger of frost.

The effect of plant cover

If the plant cover is quite low, it can be considered as part of the surface, but if it grows to some height it tends to create up to this level a special plant climate. A plant cover absorbs part of the incoming radiation; the lower parts of the plants receive less radiation than the higher ones. For instance, in a meadow with grass 3 ft. high 95 per cent. of the incident radiation penetrated to 1½ ft., 25 per cent. to 4 in., 18 per cent. to the ground. Under clover 1 ft. high the brightness of the light was only 3 per cent. of that in the open.

The Temperature Gradient in Crops

This absorption of radiation by the plants during the hours of daylight may displace the temperature maximum from the surface to some higher level. In a bed of Antirrhinum 6 in. high, the highest temperature at midday was found near the ground; it exceeded the temperature at 3 ft. by 3°F. Two months later, with plants 2 ft. high, the maximum temperature was at the upper level of the plants

TABLE III

Midday Temperatures in a Field of Sugar Cane.

Height (ins.)	½	4	8	20	40	80
Temp (°F.) in Sugar Cane	72	74	76	78	80	80
Temp. (°F.) over Bare Ground	97	90	88	86	84	82

and exceeded the temperature immediately above the ground by 5°F. In a grass-covered meadow the temperature 1 ft. from the ground was 14°F. higher than in the lowest 2 in. This explains why vigorous growth starts frequently only after the individual plants have spread enough to touch one another, forming a fairly even sward. Before this stage of growth is reached by the smaller plants, all are under the influence of the excessive heating of the ground layer near midday whilst afterwards most of the smaller plants are below the hottest temperatures at the top of the plant cover.

On the other hand, in a type of crop which even in full-grown condition is sufficiently sparse to let a big proportion of the radiation penetrate to the ground, the highest temperatures are always immediately above the ground. This applies, for instance, to winter rye in which during midsummer the temperature of the ground layer was 6°F. warmer than at the level of the ears.

The vertical temperature distribution is again quite different if the ground is very wet as with irrigated crops. Table III shows the vertical temperature distribution in a sugar cane crop 9 ft. high and over neighbouring bare ground, in India. The temperature near the moist ground in the crop is very much lowered.

Differences between plant and air temperatures

Not only the ground, but the plants themselves frequently have a temperature which differs considerably from that of the surrounding air. At midday leaves can be 20°F. warmer than the air and may even in temperate climates exceed 120°F. At night the leaf surfaces are about 5°F. colder than the surrounding air. These differences should not be overlooked when the questions of evaporation from the plant and of damage by heat and frost are considered.

Similar differences originate if flowers or buds are enclosed in gauze or cellophane covers, as is frequently done as protection against wind or insects. In a cellophane cover the plant temperature can easily exceed the simultaneous air temperature by 25°F.; the better ventilation in the gauze reduces this difference to about one-half.

The Effects of Vegetation on Humidity

Humidity conditions, too, are modified by vegetation. During daytime the humidity inside a plant cover is generally higher than outside. The reason is that the plants evaporate freely and that less moisture is removed on account of smaller wind velocity and turbulence in the air. For instance, on a sunny summer day with a temperature of 80°F. the following relative humidities were measured in a meadow: 1½ ft. upper level of grass, humidity 50 per cent., 2 in. in grass, humidity 96 per cent. The higher humidity tends to lower the evaporation from the plant and thus protects the plant against a dangerous loss of moisture. The humidity conditions in a crop might vary considerably with the density of sowing as shown in Table IV.

TABLE IV

Effect of Crop Density on Humidity (in a Maize Crop)

Sq. in of leaf surface per cu. in. of air space	0.7	0.4	0.15	0
Relative humidity (%)	75	65	50	40

The Effects of Vegetation on Wind Velocity

Vegetation has a particularly marked influence upon the wind. In the interior of a close plant cover there is practically no wind at all. Even on the leeward side of plants, as for instance of a windbreak of trees, the wind velocity is strongly reduced. At a distance of about 10 times the height of the plants the wind speed is $\frac{1}{2}$ of that in the open, at a distance of 40 times it is still less than $\frac{3}{4}$. This decrease in wind velocity also has considerable influence upon the water economy of the ground and of the plants because evaporation varies approximately with the square root of the wind velocity. Hence the far-reaching value of shelter belts in windy regions.

Some Examples of Ways to Modify the Microclimate

Wind breaks and shelter belts can be used to modify, for agricultural purposes, the climate in the living-space of the plant. They have been extensively used in the drier parts of the U.S.A. and of the Soviet Union. Modifications of climate on a still larger scale, for instance, the increase of rainfall by the creation of extensive water surfaces in Central Australia, are based on wrong conceptions regarding the forces determining the climate, or are impossible with the present technical means or are at least economically unsound. It cannot yet be decided whether the artificial stimulation or prevention of rain by seeding of clouds can become of practical importance.

Avoid unfavourable microclimates where possible

It is, on the other hand, quite possible and frequently advisable to change the microclimate of a given locality. It should, however, be stressed in this connection, that in the case of sensitive crops, it is generally much better to study the microclimatic conditions beforehand and to avoid places with the likelihood of an unfavourable microclimate. The best time to protect an orchard against frost is the time when the orchard is being established.

Prevention of frost damage

Measures to change the microclimate can be either permanent or temporary. Among the temporary measures, the best known and most widely used ones, are those for the protection of vineyards and orchards against frost damage by heating, sprinkling or ventilating. Among the permanent measures against the same danger, those which prevent the formation and accumulation of cold air pools are most important. To hinder the formation of cold air, swampy valley floors can be drained because in the dry state they collect more heat during the day. Alternatively, ponds can be dammed, because during a frosty night they give off considerable amounts of heat stored during the day by the water by virtue of its high specific heat. Cold air once formed can be denied access to the endangered places by blocking the influx of cold air from the side valleys and by deflecting the cold air flow in the main valley by the planting of hedges. Sources of cold air formation such as patches of scrub, can be replaced by heat-storing woods. A free run-off of the cold air can be provided by removing obstacles, such as embankments or rows of trees below the danger zone. There are innumerable other ways of improving the microclimate of a given locality.

In this work concerning application of microclimatic considerations to agriculture, close collaboration between the practical farmer, the agricultural scientist and the meteorologist will lead to the mutual benefit of all.

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PROGRESS IN THE NEW SOUTH WALES POTATO INDUSTRY THROUGH VARIETAL IMPROVEMENT

By J. G. CARROLL

INTRODUCTION

Potatoes have received the attention of plant breeders in other parts of the world for a century or more, but, until recent years, they have been neglected in Australia. Because of their importance as a food and because they suffer relatively more damage from diseases, insect pests and seasonal vagaries than most other food crops, potatoes surely deserve more attention from research workers.

New South Wales produces only one-third (or £1,000,000 in value) of her total annual requirements of approximately 140,000 tons of potatoes. It may be deduced from figures supplied by Bald (1941) that the annual loss in production which may be attributed to attack by diseases and insect pests is in the vicinity of 20 per cent. of the total crop, that is a loss of approximately £200,000 per year.

In addition to being susceptible to attack by certain insects and diseases, our present commercial varieties have other undesirable features. For example, the drought resistant variety Factor (Up-to-Date), in contrast with varieties such as Sequoia and Monak, sets a low percentage of marketable tubers under poor to average soil conditions. This is due mainly to an hereditary tendency for second growth. Healthy strains of this variety have been shown to give about 27 per cent. of marketable tubers over several seasons at Guyra, out of total yields of up to 4 tons per acre. The average State yield is only 2.6 tons per acre, and serious yield reductions of marketable tubers occur every season through this particular deficiency of the Factor variety.

REVIEW OF POTATO BREEDING WORK DONE IN NEW SOUTH WALES

Information on certain phases of the raising, testing and naming of the varieties Monak, Moona and Adina, has already been published (Division of Plant Industry, 1949.)

The work commenced in 1929 when Dr. S. L. Macindoe was concerned chiefly with the isolation of higher yielding and more vigorous strains of the variety Factor. The release of superior Factor strains to approved growers, together with the adoption of seed certification schemes under the direction of Mr. A. Pinn in 1932, marked an advance in the industry.

Mr. H. Wenholz, as Director of Plant Breeding, introduced over 700 different potato strains in a little more than a decade. This collection contained most of the more prominent overseas varieties, selected for their possible value either in breeding programmes, or for direct commercial use. Also included were some of

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the wild South American species and their hybrids which are expected to be of even greater significance to the potato industry, than have been the "durum" and "emmer" wheat species used in breeding for stem rust resistance in the wheat industry. Katahdin was the most notable early introduction (1933). It has been valuable both for direct commercial use and as a very desirable pollen parent. Of other commercial types tested, Sequoia, Sebago, and Saranac have been outstanding in variety trials, and they have now become firmly established in commercial areas throughout New South Wales. Their main virtues are their high yielding ability, field resistance to late blight, and in the case of Sebago and Sequoia, their ability to produce a high percentage of marketable tubers under a wide range of environmental conditions.

Late blight immunity was established under both field and glasshouse conditions for *Solanum demissum* and *Solanum Antipoviczii,* and for certain *Solanum demissum* x *Solanum tuberosum* hybrids received from Great Britain, and the United States of America. Seedlings were raised from a small number of crosses made between the latter mentioned hybrids and commercial varieties, but no acceptable commercial types were recovered therefrom. Negative results were also obtained from crosses made between certain introduced *Solanum Rybinii* x *Solanum tuberosum* hybrids and commercial varieties in an attempt to recover locally adapted types with superior virus resistance.

In 1939, on account of the very limited facilities in existence at the time, it was decided to concentrate attention on a less attractive but an apparently more certain goal, by using commercial varieties exclusively in cross-breeding work. These crosses were calculated to produce high yielding lines of superior culinary quality with increased resistance to virus diseases, and with field resistance to late blight. Accordingly, in the 1940-41 season, a number of crosses were made, including pollinations of Katahdin on to S. 41956, Peachblow, S. 44537, Early Rose x (Kerr's Pink x 110), Epicure x *Solanum Rybinii,* Gold Coin, Guyra Blue, Pontiac, Factor and Saranac (then designated 336-144). Other crosses included pollinations of Saranac on to S. 41956, Factor, Pontiac, Gold Coin, S. 46000, Red Snooth and D.15/36 (Satisfaction x Katahdin seedling produced by Mr. J. E. Dodds of Batlow).

A total of some five thousand seedlings were raised and selected in the 1941-42 season at the Guyra Trout Hatchery Plot. Further selection was carried out in these progenies by Drs. E. T. Edwards and J. G. Bald in the 1942/43 and 1943/44 seasons. Subsequent selection involved yield testing, and field tests over several seasons for resistance to virus diseases, late and early blights, common scab and brown fleck. Twelve of the best seedlings were then submitted for culinary tests to officers of this Department and the C.S.I.R.O., and to virus tests by Dr. J. G. Bald, of C.S.I.R.O., at Canberra. The more promising selections were then included in District Agronomists' Field Trials throughout the State over a period of three years.

Of these lines, two selections from the Pontiac x Katahdin cross (S. 2510 and S. 2511) and one from the Factor x Saranac combination (S. 2520) proved to be outstanding, and they were subsequently named respectively with aboriginal titles as Monak ("Sunshine"), Adina ("Good") and Moona ("Plenty"). Monak and Adina have good field resistance to late blight, and produce a high percentage of marketable tubers under a wide range of environmental conditions. It is possible that other selections from the Pontiac x Katahdin cross may yet be named, including S. 2513 (a very early type), S. 2512 (early maturing) and S. 2514 (a late type). It is interesting to note that the Pontiac x Katahdin cross involving

two early maturing varieties, yielded seedlings ranging in maturity from very early (S. 2513) to late (Monak).

FUTURE BREEDING OBJECTIVES

In order to ascertain the characters which may lend themselves most to future improvement, considering present day losses and crop-needs, it is proposed to review the main characters in relation to the parents available.

Yielding Ability

It has been suggested by Bukasov and Lechnovitz (1935) and other workers, that the *Solanum andigenum* species might be able to contribute superior yielding ability to domestic varieties, by reason of its abundant and efficient root system.

It should be of particular moment to the New South Wales potato industry, that some of the newly discovered wild species may prove useful in sub-tropical areas, where light, temperature and other climatic conditions correspond more closely to those found at the ancestral home of the potato.

Drought and Heat Resistance

Varieties are required for New South Wales conditions which will withstand a dry spell of at least a month, and then recover to give a fair crop. Although varieties such as Factor and Sequoia give very satisfactory reactions to such periods of drought and heat, it is possible that species such as *Solanum andigenum, Solanum Millanii* and *Solanum Neoweberbaueri* may be able to contribute superior factors in this regard.

Frost Resistance

Although *Solanum acaule* is known to stand up to 6°C. of frost for a limited period of time, New South Wales will have to rely on workers overseas to provide initial *Solanum acaule* material to enable a measure of this resistance to be successfully transferred to commercially acceptable local varieties. Three back-cross hybrids of *Solanum acaule* x *Solanum tuberosum* origin, reputed to have a certain measure of resistance, have been introduced by the New South Wales Department of Agriculture, indirectly through Great Britain, from the Kaiser Wilhelm Institute, Germany.

Cooking Quality

The factors for both yielding ability and culinary quality must both be considered in the production and release of new potato varieties. The tendency to produce varieties essentially to "fill the bags" is fortunately a rapidly fading policy in most plant breeding programmes throughout the world today, and greater emphasis is being placed on nutritional qualities. Garber (1945) has expressed the viewpoint that "the plant breeder has a very definite responsibility in helping to place man on a higher nutritional plane and hence to help to make him a more effective and contented member of society." Under present circumstances some culinary quality studies are undertaken by the Fruit Preserving Officer, Division of Horticulture, of the New South Wales Department of Agriculture.

Although the high energy value of potatoes is widely recognised, it is less appreciated that potatoes are the chief anti-scorbutic agent in New South Wales. Wardlaw *et alia* (1948) have shown that potatoes contribute approximately one-half of the quantity of Vitamin C consumed annually in this State. Workers at Cornell University (1947) have pointed out that some new seedlings possess approximately 50 per cent. more Vitamin C than ordinary commercial varieties. Breeding for a high Vitamin C content would thus seem to be both a desirable project and a field of possible immediate fulfilment.

As good culinary quality is usually associated with a high specific gravity figure, some progress can be made in the preliminary selection of material for

culinary quality by means of specific gravity tests.

Insect Resistance

The potato moth (*Gnorischema operculella*) is by far the major insect pest of the New South Wales potato industry. Preliminary tests carried out by Lloyd (1950) have failed to reveal any commercial variety with appreciable resistance to this pest in the foliage. Some varieties such as Pontiac and certain cross-bred seedlings have shown a worthwhile degree of escape from moth infection in the tubers.

As foliage damage caused by this insect can at present only be controlled at a comparatively high cost, it seems desirable that representatives of the Commonwealth Potato Species Collection should be tested for their reaction to this pest.

Resistance to Diseases

Virus Diseases

Hutton (1948) has clarified the position for breeding for resistance to the virus diseases of potato in Australia. "Leaf-roll" is by far the most important virus disease of potatoes in New South Wales, and none of the present-day commercial varieties in this State offer good resistance to it. Some lines received (through Great Britain) for testing for leaf-roll resistance include certain of Muller's "A" lines, viz., A.1494, A.1680 and A.1736. These types proved outstanding for general virus resistance in the field, in tests conducted over several years throughout Middle and Eastern Europe. It may be necessary to introduce factors for aphid resistance, proved for certain varieties such as Sequoia by Adams (1946), in order to produce varieties highly resistant to leaf-roll.

A start has been made at Glen Innes to produce locally acceptable varieties containing a high measure of virus resistance from parents provided by C.S.I.R.O., Canberra. Thus the C.S.I.R.O. seedling 11-84 (immune to virus X, field immune to viruses "Y" and "A", and possessing a good reaction to leaf-roll) has been crossed with the more locally adapted and field late-blight resistant types Adina and the seedling S.2514 (Pontiac x Katahdin).

Spotted Wilt has caused serious losses to growers in New South Wales, and resulted in the rejection of three hundred acres of this crop for seed certification purposes in the 1946-47 season. Although only sporadic in ocurrence, it should be considered in the testing of future promising seedlings and varieties for possible release to growers. Good resistance to spotted wilt is available in certain commercial varieties. (Hutton, 1948).

Late-Blight (Phytophthora infestans)

This disease may cause very serious losses to the potato industry and is usually found to be particularly destructive in the relatively small acreage of autumn sown coastal crops in New South Wales. Incomplete though valuable protection is available in the varieties Monak, Adina, Sequoia and Sebago to this disease. High resistance, but not immunity, is possessed by the varieties Essex, Fillmore, Placid and Ashworth of *Solanum demissum* extraction produced by Dr. Reddick of Cornell University, New York, according to preliminary results obtained from an autumn-sown trial at Grafton High School in the 1950 season.

Early Blight (Alternaria solani)

This disease rivals the late-blight fungus in importance in New South Wales crops, and on account of its regular natural incidence at Glen Innes, it has been possible to select seedlings resistant to this disease. Thus the varieties Monak and Adina possess a moderate resistance, while seedlings S.2674 and S.2675 (both from the cross Satisfaction x Douglass Seedling X Katahdin) have shown high resistance. A wild type, Chata Negra, was shown to possess a very high resistance to early blight at Orange

in the 1949-50 season by Mr. R. C. Madsen, District Agronomist. This observation was confirmed during the same season in the plant breeding plots at Glen Innes.

Common Scab (Actinomyces scabies) and Rhizoctonia Scab (Rhizoctonia solani)

Common Scab may occur in most districts in New South Wales, and is particularly prevalent in the Orange district. Certain progenies are undergoing selection to combine the moderate common scab resistance of the varieties Seneca and Cayuga with agronomically desirable features of other commercial types. Some indication of moderate scab resistance has been shown by the commercially promising seedling S.2514 (Pontiac x Katahdin).

Rhizoctonia scab must be seriously considered in the New South Wales potato breeding programme. Degrees of tolerance, if not of resistance to this disease, may be observed in hybrid populations. A technique is required for the controlled testing of more advanced seedlings, parents and promising commercial introductions for resistance to this disease.

Fusarium Wilt (Fusarium sps) and Blackleg (Erwinia Sp.)

Fusarium wilt can occasion serious losses in New South Wales potato crops. Goss and Jensen (1941) working in the United States of America found that Pontiac, Katahdin and Sebago possessed a good degree of resistance to this disease, while Iubel was classed as being highly resistant.

Blackleg is not a problem as a rule in potatoes in New South Wales, but the disease appeared in epidemic form in 1949 in the Grafton district in spring-sown crops of the Sebago variety grown under wet conditions. Sclerotinia Rot (*Sclerotinia sclerotiorum*) disease was responsible for additional serious losses to potato crops in that area in the same season, although the disease is not usually of much consequence in this State.

Brown Fleck

This disease can assume serious proportions in the hotter soils of New South Wales, when highly susceptible varieties are planted. The reputedly common scab resistant variety Ontario is rated in the very susceptible class, while the varieties Satisfaction, Monak, Sebago and Katahdin are rated as moderately susceptible, in decreasing order of susceptibility. Adina, Sequoia, Moona and Factor possess at least a moderate resistance. Green (1948) cites Arran Consul, King Edward and Arran Chief as being resistant to "potato internal rust." Most cross-bred progenies at New England Experiment Farm have been found to contain types possessing at least a moderate resistance to Brown Fleck.

General Agronomic Characters

Foliage

It is considered that the foliage should be vigorous, preferably dark green in colour, and with single-stemmed upright haulms. The healthy leaves should not simulate virus disease in appearance and should be neither of an upwards-rolling habit, nor of a rugose nature, in order to facilitate the identification of virus diseases.

Length of Stolon and Depth of Tuber-Setting

The tubers should be set deeply enough to allow escape from injury by the potato moth in a dry season, and as close as possible to the stalk consistent with yielding ability, in order to facilitate digging. In the event of potato moth damage being minimised in the future through cultural, biological, or other methods of control, including the breeding of resistant varieties, depth of tuber-set could be much less in order to reduce cultivation and digging costs. Types like Factor, which set their tubers close to the surface, will always need to be avoided on account of the damage occasioned to the tubers by sunburn.

Tuber Characters

For most purposes, a variety is required that will set a number of even sized, round to oval-round shaped tubers under a wide range of environmental conditions. The tubers should be easily detachable from the vines when harvested immature. The average weight of tubers should vary from about 6 ounces in varieties for ordinary domestic purposes, to approximately 8 ounces for the hotel, restaurant and chip trade. The necessity for a variety to consistently produce a high percentage of marketable tubers has been emphasised earlier in this paper. Varieties like Katahdin possess the very desirable faculty of being able to develop a number of tubers dependent on the prevailing weather conditions, and a high percentage of these usually attain marketable size. Evenness of tuber size tends to promote a more even article from a culinary point of view, and entails less waste in paring.

Varieties should be produced which will exhibit a minimum of second growth characters, including protuberances, elongations, growth-cracking of the tubers, and the 'hollow-heart" condition. Cultural practices aimed at providing good even growing conditions, including judicious use of irrigation, can do much to minimise this trouble in susceptible varieties.

The skin should toughen early, and be as attractive looking and bright as possible, consistent with its role in providing transport and storage protection, and in providing mechanical and physiological factors for resistance of the tubers to insect pest and disease attack. Skin colour is considered to be relatively unimportant at present.

The flesh should be firm, white and should possess an even distribution of starch grains of small to medium size. There should be a relative absence of pith cells, and a complete absence of internal pigmentation of any kind. The flesh should possess good wound healing capacity (i.e., ability to form a continuous cover of callus tissue on a cut surface). This is important both from the point of view of ability to cut setts to germinate in the open field, and for the harvested tubers to withstand rots in storage. Varietal differences in ability to heal cut surfaces have been shown by Priestly and Woffenden (1923). The variety Moona appears to be particularly satisfactory in its ability to give a high percentage germination from cut setts in the field.

The eyes should be shallow, and of sufficient number and even distribution over the tuber to permit of setts being cut from whole tubers with at least two eyes per sett. A lack of apical dominance of the eyes is a desirable feature.

Keeping Quality

There is a certain degree of positive correlation between good keeping quality and lateness in maturity. However, it would be desirable to investigate all the factors concerned with good keeping quality of potatoes.

INTERNATIONAL IMPLICATIONS OF POTATO BREEDING

It is apparent that the organization of improvement work with potatoes has considerable international implications, and in many of its aspects this project could be organized on an international scale. The most vigorous attempt at dealing with potato problems prior to World War II, from a world standpoint, reached expression in the formation and functioning of the "International Commission for the study of the potato." This Commission was appointed during the Congress of the International Association of Plant Breeders, held at Berlin in June, 1931 (Stuart 1934). This Body ceased to exist at the outbreak of war in 1939. The Food and Agriculture Organisation has already commenced work on the collection of data on wheat types, and it is to be hoped that potatoes will be listed for early treatment at this international level.

Workers wih the newly discovered South American species are providing a truly international service. It is to be expected that research with the Commonwealth Potato Species Collection at Cambridge University, and with similar species in other countries, will provide rich chapters for the pages of the world's future potato history.

ORGANIZATION OF POTATO RESEARCH IN AUSTRALIA

A number of the major problems confronting the New South Wales potato industry, including resistance to the potato moth, and improvements of culinary quality are common throughout Australia, and could perhaps be undertaken best on a Commonwealth wide basis.

Other problems such as adaptation to soil and climate are purely regional in character, and rightly lie within the province of the various State Departments of Agriculture. Some approach to an ideal arrangement in potato improvement in Australia is in evidence at present, in that the C.S.I.R.O. is undertaking the responsibility for research with certain fundamental problems of disease resistance, while the State Departments, in accordance with existing facilities, are endeavouring to obtain economic results from this and other work.

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SYMPTOM EXPRESSION OF POTATO LEAF ROLL VIRUS AS INFLUENCED BY SOIL CONDITIONS

By D. O. NORRIS, J. H. E. MACKAY and G. P. KELENY

The intensity of expression of leaf roll symptoms has been shown by several workers to be strongly affected by nutritional conditions, (Felton, 1948; Richards, Jones and Dunn, 1946). During the summer of 1947-48 two striking examples of the effect of soil conditions on leaf roll expression were observed in the field in the vicinity of Canberra, Australian Capital Territory. They were of exceptional interest in that they occurred in two different potato varieties and on two entirely different soil types.

Case 1. Yarralumla Government Nurseries

The soil on this area is a poor, reddish clay loam, high in manganese, occurring on the crest of a spur. For approximately 30 years the area had been under orchard without any added fertilizer. In 1946 the ground was cleared and fresh sewage sludge was applied at the rate of approximately 20 tons per acre and ploughed in when dry. The area was sown to ornamentals during September and October 1946. In December all species were affected by severe manganese toxicity. pH readings were 4.3-4.4 in badly affected areas compared with 4.9 on untreated headlands. It was considered that the sewage sludge had lowered the pH sufficiently to render an excess amount of manganese available to the plants. To correct this condition agricultural lime was added to the soil. Part of the area received an estimated 10-12 tons of lime per acre while part received a lighter dressing of 4-5 tons per acre. These areas will be referred to as high-lime and low-lime areas.

On 5.x.47 a crop of potatoes, var. Factor (Up-to-Date) was planted so that part of the crop was on the high-lime ground and part on the low-lime ground. When inspected on 15.xii.47 a striking difference between these two sections of the crop was observed (Fig. 1.). The crop on the high-lime area was of vigorous normal appearance, the plants being 2 ft. 6-in. in height and in full flower. Plants on the low-lime area were 6-12 in. in height with marked inter-veinal chlorosis, and had not flowered. pH readings on the two areas were 6.4 and 5.3 respectively and the estimated amounts of readily available manganese were 302-303 p.p.m. and 371-374 p.p.m. respectively.*

*We are indebted to Dr. C. Piper, Waite Agric. Research Institute Adelaide, for these determinations.

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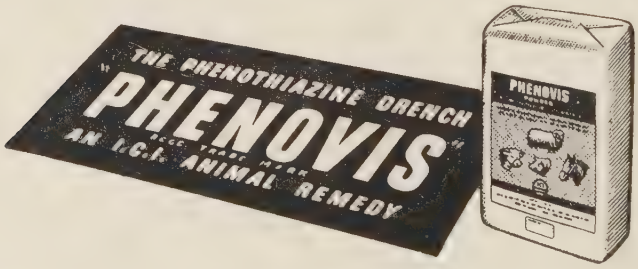

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Figure 1.

Potatoes var. Factor 71 days from planting on ground receiving different quantities of lime following sewage sludge. To left of stick potatoes on low-lying area show stunting, marked manganese toxicity and strong secondary Leaf Roil symptoms. To right of stick, potatoes on high-lime area are vigorous and normal in appearance.

The entire crop was rated for secondary leaf roll by recording only those plants in which rolling of the basal leaves and stunting of the plant was sufficiently marked to allow a positive diagnosis. No attempt was made to distinguish current-season infected plants because most of the plants on the low-lime area were showing the strong "pseudo-primary leaf roll symptoms" noted by Hewitt (1946) as characteristic of manganese toxicity. On the high-lime area 16 per cent. of plants were recorded as secondary leaf roll, but almost all of these were making growth very little inferior to that of the healthy plants. By contrast on the low-lime area 29 per cent. of the plants were showing very marked secondary leaf roll symptoms. Since the seed used to plant the entire area was obtained from the one source one would expect a uniform distribution of secondary leaf roll. It would appear that 13 per cent. of plants on the high-lime area were affected by secondary leaf roll but were passed over as healthy or as doubtful infections.

Unfortunately sampling of this crop for diagnosis of phloem necrosis by the phloroglucinol technique (Wilson 1948) could not be made until six weeks later by which time extensive current season infection had occurred and nearly all plants gave a positive reaction. That this positive reaction was a true diagnosis of leaf roll and not due to any effect of excess

manganese was confirmed by growing progeny tubers in the greenhouse.

Case 2. Molonglo River Flats

This potato crop, of the variety Katahdin, was planted on 8.xi.47. The seed used had been grown on the same ground in the previous season. Part of the crop was on fertile dark-grey silty loam on the river flat, but part of it extended onto a sandy ridge where the soil was considerably poorer. When first observed on 16.i.48 the relative fertility of the two areas could be assessed at a glance, the plants on the high ground being small and compact and the rows well separated, whereas on the river flat the growth was lush and dense, the rows being almost obliterated. Secondary leaf roll was obvious on casual inspection on the high ground but was difficult to detect in the lush crop on the flat.

On 20.i.48 a random sample of 50 plants was drawn from each portion of the crop. Each plant was rated for secondary leaf roll before being dug. From each plant a stem was preserved in 50 per cent. alcohol for phloroglucinol testing and 2 tubers kept for confirmation of infection by growing in the greenhouse. Of the 50 plants from high ground 14 were rated as having secondary leaf roll and one as a doubtful infection. Of the 50 plants from low ground 10 were rated as having secondary leaf roll and three as doubtful infections. As in the crop at Yarralumla the leaf roll infected plants on the low ground were mostly little different in vigour from normal plants and were rated largely on the rolling of the basal leaves. Phloroglucinol tests, confirmed by progeny testing in the greenhouse, gave 15 positives for the high ground lot and 16 for the low ground lot, indicating that secondary leaf roll was actually uniform throughout the crop.

Conclusions

In the instance of the Yarralumla crop the observed difference in expression of leaf roll symptoms was brought about by gross interference with the soil, but in the Molonglo River crop the difference occurred as a result of natural variation in soil fertility. It is apparent that with the varieties Katahdin and Factor the fertility status of the soil must be taken into account when assessing the crop for leaf roll, as for instance in certification inspection. The accuracy of a leaf roll rating would automatically be open to doubt if a crop were making lush growth. In some crops an inspector could take advantage of variation in soil fertility by assessing the crop on such portion or portions as happened to be on the least fertile land, but in crops planted entirely on rich soil it would be necessary either to examine a portion of the crop in close detail or to sample a representative number of stems and test them by the phloroglucinol technique.

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SEEDLING BLIGHT III. CONTROL OF SEEDLING BLIGHT OF OPIUM POPPY BY LIMING

By H. R. ANGELL and K. LOFTUS HILLS

Summary

Seedling blight of poppy on the local experiment station soil is caused by species of Pythiaceae most probably the genus *Pythium*. It is not controlled by dusting the seed with any of the six fungicides tried, nor by adding farm-yard manure, nor a full nutrient solution, to potted soil. It is adequately controlled in the greenhouse and field by liming the soil.

Introduction

Establishment of poppy (*Papaver somniferum* L.) seedlings under field conditions at Canberra has been generally unsatisfactory, having been less than one per cent. in some of the seven years in which experiments with the crop have been attempted. Pre- and post-emergence death of seedlings have been observed. Species and strains of *Pythium* have been repeatedly isolated in pure culture from dying seedlings in pots of soil from the Experiment Station, and other sources in and beyond the Australian Capital Territory.

The investigation of methods for the control of seedling blight of poppy is described in this paper. The investigation also included an attempt to find out whether species, probably of *Pythium*, isolated from dying pea (*Pisum sativum* L.) and poppy seedlings, caused this blight.

Materials and Methods

Pot experiments were made in a basement which was illuminated by fluorescent tubes giving an average illumination of 330 foot candles at seedling level. The general environmental conditions were suitable for the development of seedlings.

Experiment Station soil was placed in galvanized iron cans, each holding approximately 2.5 kg. of soil.

The fungicides used in one experiment were:—

(a) Cuprocide (cuprous oxide) made by Röhm and Haas Inc.

(b) Fermate (Ferric dimethyldithiocarbamate), made by Dupont de Nemours Co.

(c) Ceresan, made in England, and supplied by Bayer Pharma Pty. Ltd., Sydney, N.S.W.

(d) Soltosan, made in Germany, and supplied by Bayer Pharma Pty. Ltd.

(e) Agrosan G., supplied by Imperial Chemical Industries of Australia and New Zealand.

(f) Tetroc (tetra-chloro-para-benzoquinone), made by Timbrol Ltd., Rhodes, N.S.W.

According to Johnson (1946) 100°C. for one minute, or 60°C. for seven minutes, is sufficient to destroy most soil borne organisms causing plant diseases. Partial sterilization of soil used in the work here reported was effected by steaming at atmospheric pressure for eight hours. The margin of safety was therefore ample, and it was evident, from the results of these and earlier experiments, that the organism was destroyed by such steaming. To eliminate differences in moisture content, which almost invariably ocurred during steaming, soil in all the pots was afterwards mixed in

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another vessel, re-potted, and transferred to the basement.

Five grams of ordinary hydrated agricultural lime or 25 grams of sheep manure, were mixed throughout the top two inches of soil in the pots requiring such additions. A complete nutrient solution was added to other pots. To other pots, combinations of two, or all three, were added. The complete nutrient solution consisted of the following, the quantities being at the indicated rates per acre on an area basis:—

Nutrient Solutions added to drums—	
Superphosphate	2 cwt. p.ac.
Ammonium sulphate	1 cwt. ,,
Potassium sulphate	½ cwt. ,,
Magnesium sulphate	1 cwt. ,,
Calcium nitrate	1 cwt. ,,
Boric acid	10 lb. ,,
Manganese sulphate	10 lb. ,,
Zinc sulphate	10 lb. ,,
Copper sulphate	10 lb. ,,
Sodium molybdate	2½ lb. ,,

Laboratory germination percentage of seed of the "English" variety of poppy was 90. Sowings in pots were at the rate of 0.25 g., an average of 650 seeds per pot, at a depth of approximately 3 mm.

Petri dish cultures of species of *Pythiaceae,* which were isolated from moribund poppy seedlings on experiment station soil, were macerated in 500 ml. of sterile water for 15 seconds in a Waring blender. 15 ml. of the suspension was made up to 50 ml. and poured over the seed in each pot to be re-infested, before covering with soil. An equal quantity of water, passed through the Waring blender, was poured over the controls.

Both pre-emergence and post emergence blight were observed, but because there was no clear-cut line of demarcation, no attempt was made to record each separately. The percentage of seedlings remaining, after apparent stability of stand was attained, was estimated three weeks after sowing.

There were five replications of all treatments.

EXPERIMENTS AND RESULTS

Pathogenicity of Two Species of Pythiaceae

The isolates used in this experiment were obtained from hosts that were germinated in experiment station soil. Four isolates from poppies and four isolates from peas were taken at random from a recently made batch. This experiment was the first to be made of the pathogenic capabilities of these isolates. Preliminary examination under the microscope revealed that the selected isolates were of two species, one with smooth, the other with echinulate, oogonia. Both species were obtained from both hosts. From the general morphological characters of these species, it appears that they are of the family Pythiaceae and, for the

TABLE I

Estimated percentage stands of poppy on experiment station soil, sterilized and subsequently re-infested with isolates of Pythium from peas and poppies.

Source and designation of Isolates	Peas A_2	Poppy 4*	Peas B*	Poppy 3	Peas F_2	Poppy 1	Peas E_4	Poppy 2	Control, not re-infested
Percentage stand of poppies	40	10	11	5	10	0	9	11	68

*Echinulate oogonia.

purposes of this paper it is assumed that they will produce zoospores and are therefore assigned tentatively to the genus *Pythium*.

The results of the pathogenicity test are given in Table I. They show that, regardless of the species or strain of the fungus, or the host from which the isolates were originally obtained, all isolates are pathogenic to poppy. Under the conditions of the experiment, in which only one soil is used as the conditioning factor, some isolates are more pathogenic than others. Pathogenicity of an isolate varies in different soils and soil treatments (Angell, 1950). According to other work, yet unpublished, isolates that are indistinguishable morphologically may vary significantly in their pathogenicity.

Effect of Dusting Seeds with Fungicides

Several trials in the greenhouse and field in preceding years indicated that there was little hope of controlling seedling blight of poppy by dusting the seed with fungicides before sowing. Another attempt was made to control the disease under the general greenhouse conditions already outlined, applying to the seed as much Fermate, Ceresan, Agrosan G., Soltosan, Cuprocide or Tetroc as it would hold.

Attack of seedlings from seed treated with Fermate was delayed for a few days, but at the end of three weeks, only a few dying seedlings remained in the untreated controls, and in all the dusted pots. It was evident at the final inspection, that the degree of control exercised by the dusts was negligible, whereas there was a full stand of healthy seedlings in limed pots sown at the same time. Three weeks after sowing, the condition of the seedlings in the best control, Fermate, and limed pots was as is illustrated in Fig. 1.

Effect of Fertilizers and Amendments on Percentage Emergence

Pot experiments dealing with some fundamental aspects of control of seedling

Figure 1.

Comparison of stands of poppy seedlings obtained by three procedures. Pot 1 was the best control, pot 2 was the best stand obtained on limed soil, pot 3 was the best of the stands obtained with Fermate-dusted seed.

blight of poppies and peas growing on steamed, limed and re-infested soils obtained from other localities were reported elsewhere (Angell 1950). It was desirable to obtain information regarding the efficacy of liming unsterilized soil from the experiment station, with a view to the application of lime as a means of control in the field. The possibilities of other means of control of the disease on this soil, such as partial sterilization by steaming, the application of farmyard manure, and inorganic fertilizers, were also tested.

To pots of steamed soil and pots of unsterilized soil, either lime, or manure, or a complete nutrient solution, or combinations of two, or all of these treatments, were added at sowing time. Pots of steamed soil, and pots of unsterilized soil without any such additions, were used as controls. The percentage stands obtained in the first sowing were recorded, the seedlings were eradicated, and the pots re-sown. Altogether, three successive sowings were made to ascertain how stable and efficient was the influence of each soil treatment on seedling blight. It was realized that to obviate chance re-infestation without creating conditions that were likely to be more deleterious to the seedlings than re-infestation, was

TABLE II

Percentage Stands of Poppies on Treatments of Unsterilized Soils

Sowings	Control	Lime	Manure	Lime and Manure	Nutrients	Lime and Nutrients	Manure and Nutrients	Lime, Manure, and Nutrients
First Sowing	26%	68%	12%	38%	28%	66%	14%	66%
Transformed Values ..	152	278	90	188	153	272	108	272
Second Sowing	9%	48%	12%	35%	15%	48%	14%	58%
Transformed Values ..	84	218	99	175	107	218	92	248
Third Sowing	3%	26%	1%	10%	4%	26%	1%	21%
Transformed Values ..	39	150	13	81	52	147	13	134

Minimum difference significant at 5% = 64
1% = 84
0.1% = 108

Treatment Effects

Sowings	Main effects			Interactions			
	Lime	Manure	Nutrients	Lime x Manure	Lime x Nutrients	Manure x Nutrients	Lime x Manure x Nutrients
First	xxx +126.6	xx —49	+24	+4	+15	+27	+18
Second	xxx +120	—3	+22	—3	+14	+10	+26
Third	xxx +99	xx —37	+16	—4	—9	+11	+18

Significant at 1.0% level xx
„ „ 0.1% „ xxx

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impracticable. The figures in Tables II and III show that re-infestation occurred in the second and third sowings, and was much more destructive in some soil treatments than in others.

The relevant results are:—

A. On unsterilized soil: (*Table II*)

1. Significantly higher percentage stands than the controls were obtained on limed soil.

2. In general, the percentage stands tended to be lower on soil to which sheep manure was added.

3. The main effect of nutrients was not significant, but there is a possibility that nutrients have a beneficial effect in the presence of both lime and manure.

B. On sterilized soil: (*Table III*)

1. Significantly higher percentage stands than in the unsterilized controls were obtained in the first sowing after steaming the soil.

2. The first stands obtained after steaming were of the same order of magnitude as the first stand on unsterilized soil to which only lime was added.

3. Compared with the controls, the percentage stands in the first sowing were not increased in pots of soil to which manure, lime or a nutrient solution was

TABLE III

Percentage Stands of Poppies on Treatments of Steamed Soils

Sowings	Control	Lime	Manure	Lime and Manure	Nutrients	Lime and Nutrients	Manure and Nutrients	Lime, Manure and Nutrients
First Sowing	58%	60%	72%	58%	48%	56%	44%	44%
Transformed Values ..	249	254	291	248	218	242	204	204
Second Sowing	1%	21%	35%	48%	2%	27%	13%	27%
Transformed Values ..	13	130	175	219	26	152	99	151
Third Sowing	0%	44%	16%	31%	0%	29%	5%	14%
Transformed Values ..	0	204	112	166	0	187	50	102

Minimum difference significant at 5% = 64
1% = 84
0.1% = 108

Treatment Effects

Sowings	Main effects			Interactions			
	Lime	Manure	Nutrients	Lime x Manure	Lime x Nutrients	Manure x Nutrients	Lime x Manure x Nutrients
First	—3	—4	x —44	—18	+16	—22	+6
Second	xxx +85	xxx +81	—28	x —37	+4	xx —45	0
Third	xxx +124	+10	x —36	xxx —71	—5	—27	+4

Significant at 5% level x
„ „ 1.0% „ xx
„ „ 0.1% „ xxx

added. The main effect of adding a nutrient solution was significant reduction in percentage stands. The percentage stands in the second and third sowings were increased by adding lime, or manure alone, to the soil. They were not increased by any other treatment. The addition of manure to limed soil decreased the stands, and so did nutrients in the presence of manure.

Field Trial

The results of the pot experiments suggested that the disease might be controlled inexpensively in the field by the application of lime. An experiment was therefore sown at the experiment station during the late summer of 1949 to determine the optimal amounts and best method of application. It appeared that only the soil in close proximity to the seed could be involved, and that the lime should be most effective if applied along the rows. However, it might be difficult under commercial conditions to mix it intimately with the soil in the seedbed, therefore three of the treatments were based on seeding directly on to lime placed in shallow rows. In the fourth treatment, lime was worked into the soil along the row with a hand rake before seeding.

Thus there were five treatments, as follows:—

1. untreated control
2. lime distributed along the rows at the rate of 56 lb./ac. before seeding
3. limed similarly but at the rate of 280 lb./ac.
4. limed similarly but at the rate of 1060 lb./ac.
5. as in 4, but the lime worked into the soil before seeding.

Six replications of 6 ft. rows were employed. The experiment was repeated on an adjacent site after an interval of three weeks, as the germination of the first sowing was irregular, because of dry, hot conditions, and uneven watering, and when the data were analysed, possible treatment differences were masked by a high error term. The numbers of seedlings counted are summarised in Table IV.

It is evident that both the light lime and the limed and raked treatments have improved the stands. The lower establishment with medium and heavy applications of lime is probably due to the

Table IV

The effect of liming on the establishment of poppy seedlings in the field.

Treatment	Number of seedlings per foot of row			
	1st experiment		2nd experiment	
	at 6 weeks	at 9 weeks	at 3 weeks	at 6 weeks
Untreated	20.5	11.8	13.6	13.3
Lime at rate of 56 lb./ac.	30.7	16.8	17.9	17.5
„ „ „ „ 280 „ „	21.9	13.7	7.9	8.5
„ „ „ „ 1060 „ „	16.1	11.0	5.8	6.4
„ „ „ „ 1060 „ „ worked into the soil before seeding	33.9	21.0	26.3	26.5
Min. difference for significance at 5% level	—	—	4 9*	—

*This figure is a mathematical approximation, as the analysis was done on square root values, and the error reconverted subsequently.

deleterious effect on germinating seedlings of a practically pure lime substrate.

Lime was raked into the rows before seeding the experimental plots of opium poppy in the autumn following these field experiments. The stand obtained was very good, and in marked contrast to that obtained in previous years.

DISCUSSION

Although the disease dealt with in this paper is one of a group that is popularly referred to as "seedling blight" or "damping off," it is essentially a root rot, for it has been observed that it is the root of the seedling which is affected primarily. Hoffer and Carr (1923), Rosen and Elliott (1925), Heck (1934), Vanterpool (1935), Angell (1943, 1945, 1947, 1950), and Albrecht and Klemme (1948) have demonstrated the importance of the soil factor in the incidence of some root rot diseases, and have devised methods of control, based on modification of the nutritional status of the soil.

The results of pot experiments reported in this paper showed that seed protectant fungicidal dusts did not control seedling blight of poppy in this soil. Steaming the soil was a temporary palliative; re-infestation soon occurred, and subsequent sowings were as badly affected as those in unsterilized soil. The only treatment which was effective was the addition of lime, the protective effects of which persisted, although to a somewhat lessened degree, up to the third sowing in pots. These results with lime were confirmed by field tests. It was clear that the application of lime before seeding provided a practical and inexpensive method of control of seedling blight of poppy at the local experiment station.

The mechanism by which liming the soil controls the disease has not been investigated. Addition of a complete nutrient solution fails to control the disease (Tables II and III). Solutions containing 50 parts per million of manganese added to a sand or blotting paper sub-strate neither affect germination nor produce seedling blight. The Experiment Station soil is characterized by a low pH, low base exchange capacity, a deficiency of calcium, phosphorus, molybdenum and probably other elements, and an excess of manganese. Although it is tempting to try to correlate the known effects of lime on these and other soil variables with the incidence of the disease, it is pertinent to note that in the same soil and under identical conditions seedling blight of peas is comparatively unimportant, and that liming steamed soil that is re-infested with the common pathogen actually increases the incidence of the disease subsequent to the initial sowing (Angell 1950).

Angell has also shown that there is a conditioning factor, inherent in some soils, which effectively controls the disease, even though a pathogen, *P. ultimum,* is present, and has suggested that the general suitability of the soil for the development of germinating seedlings of a particular species is the factor responsible. The mechanism might be analogous to that of wheat and corn in relation to their common parasite, *Gibberella saubinettii* (Mont) Sace. There was a considerable interaction between temperature and the incidence of seedling blight in these two hosts. Dickson, Eckerson, and Link (1923) showed that this interaction was due to temperature-induced changes in the composition of the cell walls of the plants. The optimal temperature for growth of each host was found to be the temperature at which there was maximal development of resistance of the cell walls to invasion by the pathogen. The view that changes in the activity of the pathogen at different temperatures may have been responsible for the observed differences in incidence of disease in corn and wheat was shown to be untenable. The subject was exhaustively discussed by Jones, Johnson, and Dickson (1926), who cited experiments showing that unbalancing the metabolism of wheat seedlings by greatly

lowering the moisture content of the soil, or decreasing the light intensity of the greenhouse, also predisposed to seedling blight. The mechanism involved in the present instance might prove, on investigation, to be of a similar nature to that dealt with by Dickson, Eckerson, and Link.

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THE PRODUCTION AND UTILIZATION OF SILAGE— A REVIEW OF WORLD LITERATURE IN ABSTRACTS

(*Commonwealth Bureau of Pastures and Field Crops Bulletin No.* 40, 1949, *pp.* 307. *Obtainable from technical bookshops or from the C.A.B. Liaison Officer,* 314 *Albert Street, East Melbourne,* C 2. *Price* 12/6.)

Bulletin No. 40 of the Bureau of Pastures and Field Crops presents in the form of abstracts a survey of world literature during the past 15 to 20 years on the subject of silage.

The first two chapters list abstracts describing conservation methods used in various countries to assist the reader in obtaining an overall picture.

The next 121 pages, apart from two devoted to forage harvesting, describe techniques for ensiling specific crops and pasture herbage of various kinds.

Scandinavian and Finnish authors continue to assert the superiority of A.I.V. silage but in the U.K., opinions are divided on the value of using acidifying agents.

American and Australian workers are in general agreement that a high quality product can be made from pasture herbage without the addition of preservatives provided due attention is given to wilting the herbage before ensiling.

The 223 abstracts given in the chapter on digestibility and effects on animal products will be useful to students of animal nutrition while the last 29 pages dealing with chemical and microbiological aspects of silage will interest workers in the pure science field.

This Bulletin is a useful reference work.

RESISTANCE TO ANGULAR LEAF SPOT AMONG VARIETIES OF BEANS

By R. D. BROCK

Summary

A method for testing the reaction of bean varieties to Angular Leaf Spot by artificial inoculation is described.

One hundred and sixty four lines of beans were inoculated with one isolate of the fungus and the number of lesions, percentage necrosis and amount of defoliation occurring on the shield leaves were recorded. Those varieties showing resistance to this isolate were retested for shield leaf and trifoliate leaf reactions using a mixture of thirteen isolates. Varieties were arranged into classes according to their resistance to the disease. Although no variety was completely immune, no defoliation or typical spore bearing lesions occurred on the highly resistant varieties. All risistant varieties were either climbing or field beans.

Introduction

Angular Leaf Spot of beans (*Phaseolus vulgaris* L.) caused by *Isariopsis griseola* Sacc. is widely distributed throughout the world (Harter and Zaumeyer 1944). In Australia the disease occurs in Queensland (Morwood 1950, Personal communication), New South Wales (Anon 1940) and Victoria (Fish 1950, Personal communication). As conditions of high humidity are essential for the development and spread of the disease, it is only of importance in the tropical and subtropical areas adjacent to the east coast and during the late summer and autumn months of the year in the more temperate coastal areas. Under conditions favourable for development of the disease, severe defoliation and pod spotting reduce both yield and quality of green bean and seed crops. Losses are greatest in seed crops and during the 1948-49 season in New South Wales, Angular Leaf Spot was regarded as the most important disease occurring in seed crops on the south coast (Anon. 1949).

Gardner and Main (1929) reported that forty common bean varieties were susceptible in greenhouse inoculation tests and that Kentucky Wonder was the most resistant of those tested. Field observations have indicated that climbing beans and Navy beans are more resistant than dwarf green-pod varieties (Anon. 1948), (Wilson 1948, Personal communication). As a dwarf green pod bean resistant to Angular Leaf Spot is required, a survey of bean varieties was undertaken in an effort to locate resistant material which would be useful either directly or as a parent for breeding a resistant variety.

Method of Testing

For testing and comparison of varieties it was necessary to produce in each test uniform severity of infection on the standard varieties. As this could only be achieved by artificial inoculation it was necessary to determine and standardize conditions of infection.

Production of inoculum

Thirteen pathogenic isolates of *Isariopsis griseola* were made from diseased plants of various varieties and from different localities in the south coast area of New South Wales. The organism had a very slow rate of growth, which was not appreciably affected by the addition to the medium of vitamin extracts or extracts of bean plants. Large quantities of the fungus were grown rapidly by seeding the surface of agar slopes with many spores and pieces of mycelium. As a safeguard against loss of virulence in culture, potato dextrose agar plus ex-

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tract of green bean pods (50 g. green bean pods per litre) was used throughout for growing cultures and re-isolations were made from stem lesions of diseased plants for each inoculation. Pieces from stems showing typical lesions were surface sterilized with 10 per cent. (W/V) bleaching powder for five minutes, incubated for five days at 27°C. to produce abundant sporulation and then rolled over the surface of agar slopes. These slopes were incubated at 27°C. for 21 days and the resulting growth used as a source of inoculum.

A suspension of spores and mycelial fragments was prepared by removing the fungal mat from the surface of the agar slope and macerating in a high speed electric blender for three minutes with 33 cc. of water for each slope. The inoculum was prepared two hours before it was to be used and the concentration adjusted to between three and four million total pieces per cubic centimetre. No adjustment was made to the relative proportions of spores to mycelial pieces in the suspension. Over all inoculations, 21.7 per cent. (standard deviation 4.8%) of the total pieces were spores.

Preparation of plants

For every test, twenty plants of each variety were grown in six-inch pots; five plants per pot. The soil and fertilizer applications were uniform throughout all tests. Plants were prepared for inoculation, twenty-one days after seeding, by pruning off all trifoliate leaves leaving only the shield leaves which are the pair of simple leaves following the cotyledons and preceding the trifoliate leaves. Tests showed that the recordings made on shield leaves of pruned plants gave a satisfactory differentiation between the reactions of different varieties and between three levels of infection. All varieties which, on shield leaf reaction, showed resistance to a standard isolate of the disease, were re-tested using a mixture of 13 isolates, recordings being made on trifoliate leaves as well as shield leaves.

If the post-inoculation conditions were satisfactory for rapid and severe development of the disease, pre-inoculation treatment by exposing the plants to conditions of high humidity for 24 hours had no significant effect on the rate or extent of disease development. Where the post-inoculation conditions were unfavourable for disease development, the pre-treatment did have a slight predisposing effect. Plants for testing were therefore not given any special pre-inoculation treatment but if the disease development was not rapid and severe the results were discarded and the test repeated.

Inoculation and disease development

The inoculum was sprayed from a hand atomiser on to the upper and lower leaf surfaces of the plant; 100 cc. of inoculum being used for each 30 plants. All inoculations were done at 4 p.m. and plants placed in muslin covered humidity chambers in which the relative humidity was maintained between 90 and 95 per cent. For satisfactory disease development it was necessary to hold the plants under these conditions for at least three days. For routine testing, plants were removed to the glasshouse bench five days after inoculation. Typical lesions developed on susceptible varieties ten to twelve days after inoculation and this was followed by heavy defoliation two to three days later. Lesion counts, estimated leaf necrosis and defoliation were recorded twelve days and also fourteen days after inoculation.

Pathogenicity of inoculum

As there was no information available on the existence of physiological races of different pathogenicity, the thirteen field isolates of *Isariopsis griseola* were compared in duplicate tests on the bean varieties Brown Beauty and Red Mexican. The limited evidence available from these tests indicated pathogenicity differences between the isolates and that

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the order of pathogenicity was the same on the two varieties. No check was made to ascertain whether any of the isolates were mixtures of strains, but the virulence of the isolate used for all routine tests was checked on each occasion by including in all tests four standard varieties, Brown Beauty, Stringless Black Valentine, Pinto and Red Mexican.

TABLE I

Recordings of Angular Leaf Spot infection on shield leaves of four bean varieties in three tests.

Variety	Test No.	Rating 12 days after inoculation			Rating 14 days after inoculation		
		Lesions/ plant	Per cent. necrosis	Per cent. defoliation	Lesions/ plant	Per cent. necrosis	Per cent. defoliation
Brown Beauty	1	382.0	98.5	22.2	399.5	99.5	86.1
	2	329.0	80.9	3.0	364.7	96.7	21.2
	3	340.0	93.1	53.8	400	100	100
Stringless Black Valentine	1	388.9	97.8	23.5	400	100	100
	2	324.7	76.4	9.4	360.5	93.8	40.6
	3	308.7	77.2	65.0	373.0	93.1	85.0
Pinto	1	285.0	63.7	22.5	355	85.4	57.5
	2	137.2	27.5	0	193.3	47.6	6.0
	3	198.4	44.5	21.0	331.1	82.9	47.4
Red Mexican	1	123.2	20.4	0	233.5	46.7	0
	2	91.3	15.0	0	140.5	31.5	0
	3	55.5	13.5	0	187.6	42.8	18.4

Results

All varieties tested have been arranged into five classes according to their susceptibility to the disease (Table II). The comparison of varieties tested on different occasions was made through the four check varieties referred to above. In all inoculations the reaction of these varieties remained stable relative to one another and they were used as a basis for classifying all varieties into groups.

Table I which lists the results with the four check varieties on three occasions, shows the range of severity of disease development on different occasions and the rapidity with which symptoms developed over the two-day interval from twelve to fourteen days after inoculation.

The varieties Brown Beauty and Stringless Black Valentine which, as can be seen from Table I, were very susceptible to the disease, were used as the standard varieties for Class 5. These varieties both showed typical lesions and heavy defoliation of trifoliate leaves. The check line of Pinto was used as the standard for Class 4. This variety which, although susceptible and showing typical lesions and defoliation on shield and trifoliate leaves, was less severely affected than Brown Beauty and Black Valentine. Red Mexican, which had typical although smaller and fewer lesions on both shield and trifoliate leaves, was used as the standard for

TABLE II

Classification of bean varieties according to their resistance to Angular Leaf Spot.

CLASS 5

Highly susceptible. Check varieties, Brown Beauty and Stringless Black Valentine. Lesion development and defoliation heavy on both shield and trifoliate leaves.

Ace	Fullgreen No. 1	Round Pod Kidney Wax
Ayse koiden	Fullgreen No. 2	Startler Wax
Belaia	Granda	Stayleys Surprise
Black Wonder	Great Northern U.I-15	Stringless Black Valentine
Brights Refugee	Great Northern U.I-59	Stringless Greenpod
Brown Bean "Aka"	Great Northern U.I-81	Stringless White Kidney
Brown Bean "Beka"	Green Refugee	Striped Bountiful
Brown Bean "Ceka"	Hawkesbury Wonder	Supergreen
Brown Beauty	Idaho Refugee	Tendergreen
Burpee Dwarf Stringless Greenpod	Landreth Stringless	The Wonder
Burpee Stringless	Logan	Tweed Wonder
Bush Burpee	Longfellow	Unrivalled Wax
Canadian Wonder	Longreen	U.S. Refugee No. 1
Clarendon Wonder	Long Khaki	U.S. Refugee No. 5
Coopers Wax	Lowes Champion	U.S. Stringless Greenpod
Corbett Refugee	Medal	Victory
Dark Green Early Canner	Mulungee	Wellington Wonder
Drought Resistant	Mulxtas	Weston
Dwarf Tendergreen	N.Z. Stringless Giant	Whole Canner
Eksteen Runner	N.Z. Stringless Greenpod	Wisconsin Refugee
Emperor William	Pale Dun	Zuker niger
Ferry's Plentiful	Poroto topero	10 unnamed varieties from Russia and U.S.A.
Florida Belle	Red Valentine	
Florida White Wax	Rogers Sensation Refugee	
	Rojo Guaria	

CLASS 4

Susceptible. Check variety, Pinto. Lesion development and defoliation typical on both shield and trifoliate leaves, but less extensive than Class 5.

Blue Pod (Blue Wonder)	Hamburger	Shravini Ghevda
Coast Pink	Hidatsa	Standard Pink
Colorado Pinto	Idaho Brown	Stayleys Star
Felthams Prolific	Pink	Sutters Pink
Field Great Northern	Pinto	Wyoming Pinto
Great Northern U.I-1	Pole Kentucky Wonder Wax	6 unnamed varieties from Russia and U.S.A.
Great Northern U.I-123		

CLASS 3

Moderately resistant. Check variety, Red Mexican. Lesions typical although smaller and fewer than Class 4. Defoliation of shield and trifoliate leaves light.

Climbing Stringless	Northern Star	Robust
Early White	Perfect	*Scarlet Runner
Fardenlosa	Pioneer	Verschoor
Michelite	Poroto criollo	Zuckers Perl White
Mombacher Juni	Red Mexican U.I-3	
Navy Bean (Canadian type)	Red Mexican U.I-34	5 unnamed varieties from Russia.

CLASS 2

Resistant. Typical lesions on shield and trifoliate leaves, always less than Red Mexican. Defoliation rare.

Blue Lake	Ideal Market	Mulitanho
Blue Podded Pole	Long White Marrow	Ousara
Doppette	Kentucky Wonder	Poroto arrozchileno
Feijao	(Brown Seed)	Preto Brilante
Golden Harvest	Kentucky Wonder	
G.150	(White Seed)	4 unnamed varieties from
Grigaijy		Russia and Argentina.

CLASS 1

Highly resistant. Very few typical lesions on shield leaves. Lesions on trifoliate leaves either atypical or lacking. No defoliation.

Alabama No. 1	Epicure	Negro Costa Rica
Cafe	Mexico Black	Scotia
California Small White	McCaslan	Rojo Chico
*Case Knife (Erecta)	Navy Bean	

*These varieties are *P. multiflorus* Willd.

Class 3. Class 2 includes varieties which were always more resistant than Red Mexican. These varieties had only a small number of typical lesions and defoliation was rare. Class I varieties were the most resistant; in these no defoliation occurred and there were no typical lesions on the trifoliate leaves.

No variety was immune and as will be seen from Table II all varieties in Classes 1, 2, 3 and most of those in Class 4 were either field beans or runner beans. Eight varieties of Lima beans (*P. lunatus* L.) were tested and all were susceptible or very susceptible.

As no hybridization has been attempted with any of the resistant varieties, no information is available on the inheritance of resistance. Several of the varieties reported here as being resistant to Angular Leaf Spot have been reported resistant to Halo Blight (*Pseudomonas phaseolicola* (Burk) Dowson), Anthracnose *Colletotricum lindemuthia-*

num (Sacc. and Magn.) Bri. and Cav.) and Root-knot nematode (*Heterodera marioni* (Cornu) Goodey) by Reid (1945) and Isbell (1931). Thus there is the possibility of providing a dwarf green-pod variety of beans with resistance to these diseases by a careful breeding programme.

Acknowledgments

Grateful acknowledgment is made to Miss G. M. Roberts, Mr. R. R. Rochford and Mr. J. D. Williams, of the Division of Plant Industry, C.S.I.R.O., for valuable technical assistance. Mr. G. A. McIntyre, of the Section of Mathematical Statistics, C.S.I.R.O., gave statistical advice and assistance.

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SOILS—THEIR ORIGIN, CONSTITUTION AND CLASSIFICATION: AN INTRODUCTION TO PEDOLOGY

By G. W. ROBINSON

(*Third Edition, revised and enlarged,* 1949.
George Allen and Unwin Ltd., London. 1949. *Price* 32/- *stg.*)

The second edition of this now standard work was last reprinted with minor corrections in 1937. In the past twelve years, in spite of the hampering of research by war conditions there have been many advances in our knowledge of the subject and an increasing interest by the public generally in the problems of soil erosion and the maintenance of soil fertility. The book is essentially an introduction to the descriptive science of the soil, and the relationship of soils to plant growth and agriculture are dealt with in a single final chapter which thus acts as a link with those texts in soil science which have essentially an agronomic outlook.

The first ten chapters deal with the general properties of soils including two chapters on soil formation one of which emphasizes the weathering process and the second the development of the soil profile. In this latter discussion on pedogenesis approximately equal weight is given to the influence of parent material, climate, topography and vegetation. Possibly in a future edition greater emphasis could be placed on the interactions of parent material and climate with special reference to cycles of weathering and the survival of soils from former climatic periods. Six chapters are devoted to the description of major groups of soils including podzols, black earths, hydromorphic soils and peats, saline and alkaline soils, soils of the tropics and soils associated with calcareous materials.

It is evident from this grouping that we need much more information on soils from tropical regions otherwise it would not have been necessary to deal with them on a regional rather than a morphological basis. The consideration of these groups leads logically to two chapters on the classification and the geography of soils. Finally two chapters on soil surveys and the associated laboratory work complete the picture. His chapter on soil classification contains some sound advice on the general principles of classification.

Our state of knowledge concerning the mineralogy of the clay fractions of any considerable range of soils is not sufficiently advanced for this aspect to be included in soil descriptions generally and it is evident that a new outlook on soil classification will emerge when these data are more generally available. In the meanwhile Professor Robinson, wherever possible, gives the silica-alumina-iron oxide ratios for the clay fractions in the characteristic profiles described. These ratios, together with content in clay and organic carbon and the pH values give a background of analytical data reasonably adequate for the interpretation of the soil descriptions.

The book can confidently be recommended to all those seeking a knowledge of modern views on soil classification and an introduction to the disciplines and literature of pedology.

J. A. PRESCOTT.

TECHNICAL NOTES

YIELD POTENTIAL OF POTATO TUBERS GROWN IN DIFFERENT SOILS

Introduction

In potato field experiments where the yields of different seed lots must be accurately compared, there exists a possibility that the soil or climate in which the seed was grown might have an effect on the yield obtained from it in the following season. Error from such a source could not be controlled by experimental design but would necessitate the growing of all seed lots side by side on the one soil for a preparatory year before the experiment could begin. In order to check whether the soil of origin can have such an effect, a field experiment was set out at Dickson, Australian Capital Territory, in the summer of 1949-50.

Experimental Procedure

Preparations for this experiment were begun in the previous season. A uniform line of virus-free Factor seed, grown in isolation at Paddy's River, Australian Capital Territory, was divided into three lots of 100 lb. each, and each lot was planted in a different soil type in the vicinity of Canberra, Australian Capital Territory, on 16.xi.48. The three sites were situated within five miles of each other and there were no gross differences of aspect or elevation. It was considered that the three lots of seed were exposed during the growing season to the same climatic conditions, the only major variable being the soil type. Lot I was planted near the laboratories at Black Mountain, on light-brown silty loam derived from quartzite and low in organic matter. Lot II was planted at the Experiment Station at Dickson, on infertile, red-brown clay loam containing ironstone gravel, low in organic matter and known to contain a high level of manganese. Lot III was planted on the fertile flats of the Molonglo River on a dark-grey silty loam high in organic matter. Because it was known from experience that without fertilizer the yield on Black Mountain and Dickson soils would be meagre, all seed lots were given a basal dressing of fertilizer containing two parts of superphosphate to one part of blood manure at the rate of 6 cwt. per acre.

During the season, growth on the Black Mountain and Dickson soils was moderate, but the plants on the latter soil developed strong potash deficiency symptoms. Growth on the Molonglo soil was extremely vigorous. The relative fertilities of the three soil types are indicated by the mean yield per plant obtained from these seed lots. These were Dickson soil 2.8 lb., Black Mountain soil 4.1 lb. and Molonglo soil 4.8 lb. The fertility of Molonglo soil compared with the the other two is much greater than is indicated by the figures because excessive top growth on this soil was not accompanied by a proportional increase of tuber formation.

Clean, sound, whole seed tubers of approximately comparable size, weight and shape were selected from the potatoes harvested on these three soils. The plot to compare the performance of these three seed lots was planted on 21.x.49 on the least fertile soil type at Dickson. A basal fertilizer dressing of 1 part sulphate of ammonia, 2 parts superphos-

phate and 1 part sulphate of potash was applied at the rate of 6 cwt. per acre. The experiment consisted of 12 rows of 165 plants, flanked by guard rows. Each plot contained each of the three seed lots and was replicated 10 times, the unit subplot being 66 plants in twin rows of 33 plants. During the growing season all plants that were in any way diseased or abnormal were rogued. At the end of the season each plant was separately harvested and a record made of the number of stems arising from the seed piece, the number and weight of marketable tubers and the number and weight of small tubers.

Results

Statistical examinations of the data revealed no significant or near-significant differences in stem numbers or yield, thus showing that there was no direct effect of soil of origin on yield capacity of the seed grown in it.

It is possible that differences would have been detected if basal fertilizer dressings had not been given, but the aim of this trial was to detect a possible source of error in comparative experiment plots that are normally fertilized.

Conclusions

Although the experiment indicated that there is no direct soil effect, observations made at planting time showed how an indirect effect might well arise. During the sorting of the seed lots produced on the three soils in 1948-49, great difficulty was experienced in obtaining seed pieces of the same weight. Seed grown on the Black Mountain soil contained a high percentage of large tubers, that grown on the Dickson soil a high percentage of small tubers, while that grown on Molonglo soil was intermediate. Despite the most careful matching the estimated mean weights of seed pieces planted in the final plot were Dickson soil 67.5 gm., Molonglo soil 74.7 gm. and Black Mountain soil 76.6 gm. It can be seen that unless great care is taken in matching seed lots from different soils a greater yield might possibly be obtained from one lot because a greater number of heavy seed pieces was planted.

It still remains to be determined whether the climatic conditions experienced by lots of seed planted in widely separated localities can exert a persistent effect on yield in the subsequent season.

D. O. NORRIS.

Division of Plant Industry,
C.S.I.R.O.,
Canberra, A.C.T.

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COUNCIL PROCEEDINGS

December Meeting

The 111th Meeting of the Council was held at C.S.I.R.O., Canberra, on Monday, December 4, 1950, at 7.30 p.m.

Present

Mr. P. A. Reid (in Chair); Mr. C. G. Greenham (Qld.); Mr. W. D. Hardy (A.C.T.); Mr. C. H. Williams (S.A.); Dr. I. Molnar (Vic.); Mr. C. M. Donald (N.S.W.); Mr. F. O. Grogan (W.A.); Dr. C. Barnard (Tas.); and Mr. G. A. McIntyre (Hon. General Secretary).

An apology was received from Mr. A. V. Hill (Hon. General Treasurer).

Salaries and Status

No further branch reports were received and Council confirmed its decision not to seek information from the remaining branches re comparative salaries and status of Agricultural scientists and other professional workers in State employment.

A statistical summary of the recent survey has been forwarded by the Melbourne University Appointments Board. Proxy Council examined the tables in some detail and expressed its pleasure at the comprehensive cross tabulations which have been made. The Secretary was instructed to convey the appreciation of Council, together with suggestions for a few amendments. The full report will be sent by the Appointments' Board early in the New Year.

Rural Extension Services

Information permitting completion of the summary schedules for South Australia, Western Australia and New South Wales, are now to hand and the data from the remaining States is anticipated soon. The Council Sub-Committee has incorporated information received and hopes to have the final report completed in advance of the General Meeting at Brisbane.

Agricultural Engineering

Comments on the Victorian Sub-Committee's Report, in addition to those received at the last meeting, have been received from the following Branches:— Western Australia, South Australia, Australian Capital Territory and Queensland.

Advice has been received from the N.S.W. delegate that the Sydney University of Technology was contacted and all relevant papers forwarded to the Registrar. The matter will be discussed at the next meeting of the Professorial Board of the University.

Council considers it essential that the final views of the Institute on training and research in Agricultural Engineering should be recorded in a report and to this end it was moved by Mr. F. O. Grogan, and seconded by Mr. Hardy:—

> "That the final collation of the Victorian Sub-Committee's Report and Branch comments thereon, together with advice from the Sydney University of Technology, be made by a Sub-Committee consisting of R. D. Brock (Convener), C. G. Greenham, C. Barnard and W. M. Willoughby."
>
> "That this Sub-Committee examine the possibility that the visit of a U.S. authority on training in Agricultural Engineering be arranged under the Fullbright Act."

Interchange of Personnel

The Secretary reported that on receipt of the letter from the Prime Minister's

Department, copies of this, together with the replies of the State Premiers (excluding Tasmania), had been disributed to branches. Branch comments have been received and Council considered that we had before us a splendid collection of political phrasing which lent itself to a variety of interpretations and generally evasive on the central issue. The view was expressed that our action has probably not been fruitless in that we have made the politician aware that the maintenance of restrictions on interchange of professional personnel is generally known and is resented and that the most profitable line of action we can take is to make the position even more widely known.

Consequently, the following motion, moved by Mr. Hardy and seconded by Mr. Grogan, was accepted:—

"(a) That copies of replies received be sent to other institutions with similar interest, and

(b) That a factual resumé of action taken by Council with respect to interchange of personnel and the related transfer of superannuation rights be published in the Journal,* and

(c) That copies of the Journal containing the article be forwarded to the Public Service Commissioners, and

(d) That further action be deferred until circumstances dictated its necessity."

It was moved by Mr. Donald, seconded by Mr. Hardy and carried:—

"That Messrs. Grogan and McIntyre prepare this report for publication."

It was also decided that the Secretary should write to the Premier of Tasmania.

Institute Scholarships

The Secretary reported that advice had been received from the Commonwealth Treasurer that under existing law taxation remission on gifts to a scholarship scheme of the type envisaged by the Institute was not allowable. However, the subject of tax exemptions was under review by a departmental committee and when its report was received, our request would receive further consideration.

One member of Council considered it possible that by alteration in some technical point, tax remission could be secured.

It was resolved on the motions of Mr. Donald, and seconded by Mr. Greenham:—

"That further advice be sought on the possibility of tax remission."

"That the South Australian Branch be requested to appoint a Council Sub-Committee to establish the machinery for the initiation and maintenance of the Scholarship Scheme."

From comments received from the Branches, Council recommends to its Sub-Committee appointed by the South Australian Branch:—

(a) That the scholarships be awarded only to members of the Institute.

(b) That a minimum amount for a scholarship be defined with scope for extra expenses and travelling allowances; that the tenure be at least one year with provision for extension, and the primary purpose of the scholarship should be training but the field of research work done could be nominated by the donor.

(c) The collection and distribution of funds must be the responsibility of the Institute. It is suggested that a Central Committee be responsible for the initiation and direction of subsequent stages of appeals, but that Branch Sub-Committees be formed to assist in nomination of donors and in consultation between the prospective donor and the Institute following the initial appeal. The same or a

*This report is published elsewhere in this Journal.

separate central committee could be made responsible for the dispersal of funds between States subject to donor's conditions.

(d) That the funds collected are to be expendable and not treated as capital.

(e) No comment on the form of acknowledgment to donors.

Agenda for General Meeting, Brisbane

The Western Australian Branch requested that the following items be included on the Agenda*:—

(a) Reorganization of Council with paid secretary and staff.

(b) Expenses of Delegates to General Meeting.

(c) Raising of members' subscriptions.

The Branch requests Council to form a Sub-Committee to determine the amount by which it would be necessary to raise members' subscriptions to cover the costs of (a) and (b) and contingent obligations which might arise. The Branch considers that Delegates to the General Meeting should be thoroughly conversant with the position prior to the meeting and that the proposed Sub-Committee Report should be available and circulated to Branches in sufficient time before the meeting for Branch opinion to be obtained.

The New South Wales' Branch also recommended that expenses of Delegates be considered.

Membership

ADMISSIONS

With the recommendation of the Branch submitting the application and the Qualifications Committee, the following applications were approved for **Corporate Membership:—**

W. H. Litchfield—South Australia.

L. W. Lockart—New South Wales.

*The Agenda for the General Meeting, Brisbane, is published elsewhere in this journal.

With the recommendation of the Branch submitting the application, the following applicant was admitted to **Student Membership:—**

B. T. Egan—Queensland.

RESIGNATION

The resignation of Mr. P. Hindmarsh from the New South Wales Branch was accepted with regret.

TRANSFERS

The following transfers were noted:—

Miss E. G. Wingrave—New South Wales to Tasmania.

Mr. R. A. Paul—Western Australia to Queensland.

Mr. K. P. J. Barley—Victoria to New South Wales.

Australian Journal of Agricultural Research

The report of the Distribution Manager was read and discussed at the meeting.

Council expressed concern that the number of subscribers to the A.J.A.R. had fallen so rapidly. This was particularly unfortunate when A.I.A.S. participation in publication of the Journal and concession rates to A.I.A.S. members had been pressed rigorously last year. Several members of Proxy Council stated they had failed to pay advance subscriptions only because of the lack of an adequate system of notifying members of the expiry of their subscriptions. The Secretary noted that conditions relating to advanced subscriptions for members after the first two issues had been printed in the March, 1950, issue of the Journal.

It was resolved:—

"That a continuing system of notification of expiry of subscriptions by the use of slips in A.J.A.R. be adopted, and that all original subscribers be circularised and given the opportunity to complete recent back numbers."

RESTRICTIONS ON INTERCHANGE OF SCIENTIFIC PERSONNEL

At the meeting of Council, December, 1950, it was decided to take no further action at present to secure the complete elimination of restrictions on interchange of scientific personnel between the public services of the States and Commonwealth. While there is no clear evidence that the protests of the Institute and similar bodies have been effective, it is likely that these expressions of resentment have produced a more appreciative attitude than existed at the end of the war to the long-term advantages of interchange between services. The position has certainly eased and while the Council is still not satisfied with the existing situation, further action does not seem warranted unless severe restrictions are re-imposed in the absence of a state of national emergency.

A review of action taken by Council follows, together with the most recent correspondence with heads of governments.

At the Ninth General Meeting held at Adelaide in August, 1946, it was resolved that Council should prepare a report on the transfer of personnel from one service to another and make it available for publication in the Journal or for distribution to members. In the December, 1947, issue of the Journal (Vol. 13, No. 4) this report, prepared by Messrs. C. M. Donald (Convener), W. Ives and G. Helson, was published. It was further resolved at the Ninth General Meeting that Council should approach the Commonwealth Authorities, and Branches the respective State Authorities, on this subject.

In anticipation of a Premiers' Conference held in August, 1947, where an item on the agenda was to discuss the recruitment of technical and scientific officers by the Commonwealth from State organizations, a letter was sent by Council to the Prime Minister. This letter indicated the Institute's vital interest in the subject, quoted resolutions of the Adelaide General Meeting and enclosed a copy of the sub-committee's report. A telegram from the Eleventh General Meeting, which was in session at that time, drew the Prime Minister's attention to this correspondence. In subsequent correspondence the Prime Minister stated that he had intimated to the Premiers that the Commonwealth Public Service Board had adopted the policy of asking the States whether they had any objection to the transfer of State Officers to the Commonwealth before making individual appointments. The item had then been withdrawn from the Premiers' Conference Agenda.

Council next approached Public Service and Professional Officers' Associations in all States seeking their co-operation in a united approach to the appropriate authorities relative to restrictive agreements hindering the free interchange of scientific personnel. On May 11, 1948, a meeting of the Joint Standing Committee of Professional Scientific Bodies was convened at Council's request, by the Australian Chemical Institute, to fully discuss the subject and plan appropriate action. The meeting was attended by representatives of The Australian Chemical Institute, the Australian Institute of Agricultural Science, the Institution of Engineers, the Institute of Physics and the Australian Veterinary Association, and by invitation the N.S.W. P.O.A.,

This report is published following resolution made at the 111th *Meeting of Council held on December* 4, 1950. *It was prepared by F. O. GROGAN and G. A. McINTYRE.*

Queensland Government P.O.A. and the C.S.I.R. Officers' Association.

It was decided at this meeting that an appropriate letter should be drafted and sent to the Prime Minister and six State Premiers.

Council approved this action but considered its viewpoint was not explicitly covered by the draft submitted for its consideration. Subsequently, an alternative draft, prepared by the President and modified after objection by the Chemical Institute, was forwarded on behalf of the Joint Standing Committee to heads of State and Commonwealth governments. Replies received were collated and distributed to the associated bodies in October, 1949.

From the replies it was evident that a written agreement to consult does exist and independently it was known that restrictive practices continued to operate. Council therefore took up with the Joint Standing Committee the question of further action to secure the cessation of the agreement. There was also before the Committee a draft letter from the Institute on extension of transfer of superannuation rights for scientific personnel in State and Commonwealth services and universities. The Committee decided to give its support to the latter and considered further action on the former issue should be deferred until replies had been received on superannuation transfer.

Council decided to take independent action and forwarded a letter as follows to the Prime Minister and Premiers—

14/7/50.

Dear Sir,

A letter was forwarded on 27/5/49 to the Leaders of the State and Commonwealth Governments by the Joint Standing Committee of Professional Scientific Bodies in protest against restrictive practices affecting the movement of scientific personnel among State and Commonwealth Public Services.

From the replies received it was evident that an agreement was reached between the State Public Service Commissioners on 16-17/4/1945 providing for consultation on the question of release of an officer from his existing employment to go to a position in another public service. The Commonwealth Government subsequently became a party to this agreement. The Institute firmly believes that the agreement is still operative in principle and in practice, particularly against the transfer of more able officers who may be less readily replaced.

The agreement means that if an officer in government employment applies for a position advertised in another government service, the prospective employer consults the applicant's present employer before accepting him as a fully eligible candidate. If the Government with whom the applicant is currently employed objects to losing the officer then this objection is recognised by the Government seeking the appointee. In practice, such an objection usually means that the candidate is eliminated from among the applicants.

As a further consequence of this difficulty of securing the transfer of professional officers a government reviewing the applicants for a professional post will pass over the most suitable applicant simply because he is in the employ of another government. In other words the difficulty of negotiating a transfer often discourages any attempt at securing the services of an employee of another government.

In our view it is unjust to allow the possibility of a temporary inconvenience to the employing body to operate as a basis for the rejection of an applicant. While all professional officers, in common with the community at large, readily accepted the need for the direction of manpower during the war, they object strongly to the continued application of this principle in peacetime to themselves alone. It is a fundamental right that any man should have freedom to accept employment with an employer wishing to engage him. Furthermore restriction in the movement of professional workers is to the detriment of national progress. It prevents the movement of competent workers to those posts in which they can best serve the community; it engenders dissatisfaction among officers who are prevented from seeking more acceptable or more remunerative work and it discourages qualified persons from entering a service from which they may have difficulty in transferring at a subsequent date.

This Institute which includes the great majority of professional agricultural workers throughout the Commonwealth, is particularly concerned with this restriction of movement of professional workers because its members are almost wholly employed in government services.

Your assurance is therefore respectfully requested that the agreement will not be allowed by the authorities under your Government to operate in their future appointment of professional personnel and that professional workers will enjoy the same privileges in the choice of employer as do all other sections of the community.

The following replies were received—

M.3/1/13.

The Prime Minister's Department,
CANBERRA.
30th October, 1950.

I refer to your letter of 14th July, concerning the movement of scientific personnel between the State and Commonwealth Public Services.

Some months ago this question was raised and I found that it had been considered very fully by the previous Government. The principle agreed upon between the Premiers and my predecessor in office is that consultation should take place so that the Commonwealth and State authorities would not be competing for the services of highly trained officials to the possible detriment of important undertakings in which such officials are engaged.

I support this principle, but whilst it exists and should be observed where possible, it is not contemplated that officers of one public service should be excluded from consideration for positions of a higher grade in another. To exclude officers of one service who are prepared to resign to accept positions in another requiring greater responsibilities would, I consider, be most unjust and, in fact, impracticable.

Premier's Department,
PERTH.
31st July, 1950.

With reference to your letter of the 14th July, I desire to advise you that the question of scientific personnel transferring between State and Commonwealth Public Services was considered last year and I enclose for your information a copy of a report submitted by the Public Service Commissioner which fully explains the position.

I am advised by the Public Service Commissioner that the fact that officers do get appointments in other Services makes it fairly clear that reference from one Public Service Commissioner to another before the selection is made does not interfere with the rights of an officer to make changes in his employer or employment at any time.

COPY OF REPORT SUBMITTED BY THE PUBLIC SERVICE COMMISSIONER.

Competition between the States and the Commonwealth for highly trained and qualified technical officers was very keen during the war period and several States, especially, were finding it extremely difficult to continue the specialist services for which they were responsible.

The position was discussed at a Public Service Commissioners' Conference held in Melbourne on 16th and 17th April, 1945, when it was agreed—"That where one State proposes to select an officer or employee from another State, before notifying the individual concerned of his or her selection, a letter should be sent to the Public Service Commissioner or Board concerned seeking their views on the question of the release of such officer from his or her existing position."

The Commonwealth was persuaded to join in this undertaking, but I doubt very much whether the enquiries which have been made from time to time, in accordance with the procedure adopted by the Public Service Commissioners, have stopped one man from accepting an appointment with the Commonwealth or another State Government.

There is only one case in my knowledge of a professional officer in our Service being restrained from taking up an appointment in another State, and in that instance the officer was under a bond to serve a term after completing a cadetship.

It can be said quite safely that the understanding has not worked to the detriment of professional officers—on the contrary it has frequently accelerated enquiries which have resulted in the up-grading of individuals and classes of officers.

I, personally, have consistently adopted the view that we cannot stop an officer from improving his position or standing elsewhere. All we can do is to co-ordinate as far as possible, our salary scales with other Services and I have found the understanding with my confreres in the other States a valuable means to that end.

It is my considered opinion that our officers as well as similar classes of officers in the Commonwealth and other State Services have lost nothing by the agreement between Commissioners, but have, in fact, gained appreciably by the higher standing which the agreement has, at least partially, brought about.

49/3211

Premier's Department,
SYDNEY.
4th August, 1950.

I refer to your letter of 14th July, regarding the transfer of scientific personnel among State and Commonwealth Public Services, and advise that inquiries in this matter show that it is the practice when applications are received from another State in response to an advertised position for the Public Service Commisioner of that State to arrange for the applicant to be interviewed and for inquiries to be made as to his suitability for the position in question. The adoption of this practice, which applies irrespective of whether the applicant is a Public Servant or not, obviates the necessity for an applicant to travel a long distance for interview unless it is reasonably certain that he will be selected for employment.

Where the applicant is a Public Servant, the Commissioner concerned is usually asked for a report as to his services and the position in which his Service would be placed in the event of the applicant's selection. These arrangements are not designed to prevent officers obtaining employment with another Service, but as a workable means of ascertaining the qualifications of applicants and at the same time ensuring some degree of co-operation between the Public Service Commissions. In any case where a Public Servant persists with his application, objection by the State concerned does not prevent his appointment.

In the circumstances it is not considered that the present practice prevents free movement of officers from one Service to another.

C.S.O.486/1949.

Premier's Office,
ADELAIDE.
26th July, 1950.

With reference to your letter of the 14th instant, regarding movement of scientific personnel among State and Commonwealth Public Services, I am directed by the Honourable the Premier to inform you that the Public Service Commissioner reports that the complaints contained in your communication have no foundation in fact, as in actual practice no barrier is placed on an officer applying for positions in other Services nor is a suitable applicant passed over simply because he is in the employ of another Government, as alleged by your Institute.

In the last twelve months, a number of transfers have taken place between the South Australian Public Service and the Public Services of other States.

Premier and Chief Secretary's
Department,
BRISBANE.
15th August, 1950.

I am directed by the Honourable the Premier to refer to your letter of the 14th July, 1950, relative to transfers of scientific personnel between the State and the Commonwealth Public Services.

In regard to this matter I am to inform you that Queensland Public Servants have the right to apply for and seek positions with the Commonwealth and other State Services and instrumentalities or with private employees. The resignations of officers of the Queensland Public Service who resign to accept other employment are accepted without question, unless they are under bond of service for a specific period.

There has been no case of a refusal to accept the resignation of an officer selected for service in the Commonwealth or other State Public Services.

In conclusion I am to inform you that Queensland is not a party to any agreement of the nature alleged in your letter under reply.

50/2114.

Premier's Department,
MELBOURNE.
30th August, 1950.

With reference to my letter of the 19th July, on the subject of the movement of professional officers among State and Commonwealth Public Services, I am directed to inform you that your communication, received on the 17th idem in regard to the matter, was referred to the Victorian Public Service Board for comment.

The Board has now advised that while, through the agency of conferences of State and Commonwealth Public Service authorities from time to time on matters of common interest concerning Public Service administration, the subject of competition between such authorities for the services of professional personnel has been discussed, there are no agreements, nor have any been sought, which would interfere with the acknowledged right of persons to make their own choice of employment.

THE FIG

By IRA J. CONDIT

(Chronica Botanica, Waltham, Mass., U.S.A. and N. H. Seward, Melbourne, 1947, 222 *pp.,* $5.00)

A notable contribution has been added to horticultural literature by Dr. Ira J. Condit with his book entitled "The Fig." As Dr. Condit has been recognised for many years as a world authority on this subject, his publication of this work was more or less inevitable.

At a casual glance the lack of photographic illustrations and detailed descriptions of cultural methods may be the cause for some disappointment, but as the author himself states, this book is not meant to be a text book and such information is readily available in official publications. In fact the standard of this book is such to make it more a classical review and the author, by the diligence of his researches, has made a comprehensive coverage of the literature relating to figs. His own previous publications figure prominently in the lengthy bibliography.

From the years of serious study with this fruit the author has been able to bring together in the one book a wealth of scientific information which would merit a place in historical as well as scientific libraries.

Chapters relating to the fig in song, story and history display a keen probing of ancient literature relating to this fruit.

For the botany student the distribution of the genus Ficus is well covered and for the entomologist there is a discussion on the unique activities of the fig wasp *Blastophaga psenes,* which plays such an important part in Smyrna fig production.

A concise description is given of the characteristics of commercial fig varieties and useful comments which may be regarded as authoritative are made on the nomenclature of certain varieties over which there has previously been some confusion. Interesting accounts of fig growing in various districts of the world must deserve attention. Cultural requirements, pests and diseases and the economics of the fig industry are dealt with briefly but adequately. It would be difficult to pose any question on figs to which an answer could not be found in this book.

A number of vignettes add to the artistic value of the work.

G. W. GAYFORD

AGENDA FOR SIXTEENTH GENERAL MEETING

Notice is hereby given that the Sixteenth General Meeting of the Australian Institute of Agricultural Science will be held on Monday, 21st, and Tuesday, 22nd May, 1951, at the rooms of the Queensland Cane Growers' Council, A.M.P. Buildings, Edward and Queen Streets, Brisbane.

Agenda

MONDAY, MAY 21

2.00 p.m.-2.30 p.m.—Meeting of Council.

1st Session

(2.30 p.m.-5.00 p.m.)

1. Formal Business: Credentials, Proxies, Standing Committees, etc.
2. Discussion of Reports presented at the Annual General Meeting, March 20, 1951.
   (a) Reports of Editor and Business Manager.
   (b) Report of Treasurer.
   (c) Report of Council on action taken pursuant of the Resolutions of the 13th General Meeting.

TUESDAY, MAY 22

2nd Session

(9.30 p.m.-12.30 p.m.)

3. Discussion of Institute policy, organization and funds.
4. Expenses of Delegates.
5. Amendment of Articles of Association.

3rd Session

(2 p.m.-5.00 p.m.)

6. Discussion of Institute Scholarships Scheme.
7. Discussion of Report on Rural Extension Services and Recommendations.
8. Other Business.
9. Resumé of Resolutions and Recommendations.
   Report of Resolutions' Committee.

Evening Session

Institute Dinner followed by

(a) Presidential Address.
(b) Award of Australian Medal of Agricultural Science.

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